AUTOMATIC CONTROL IN BIOTECHNICAL SYSTEMS

Eshonov Ravshanbek Mukhammadmusayevich
Teacher at Medical university in Fergana

Annotation: In this article, scientific research on automatic control in biotechnical systems was carried out.
Keywords: control, automatic, biotechnical, system, learn, health, AI.

Introduction. Automatic control theory is a branch of technical cybernetics that conducts scientific research on the creation of automatic control systems (ABT) of various processes of various complexity and nature. In automatic control theory n., their similar (adequate) mathematical models are used instead of real objects. It mainly deals with two problems: analysis and synthesis of ABT. The two types of control systems, i.e. open and closed control systems, differ from each other in the way they control processes. In the first one, the controlling effects are focused on reducing the difference in their saturation, based on the effects that saturate the process. The main drawback of such a control system is that it cannot eliminate external damping effects that cannot be measured. In addition, these control systems cannot control unstable objects for a long time. At the core of closed control systems is the idea of feedback. This idea is known as the deviation control principle (or feedback control). Here, due to the deviation of the control parameters from the required level, execution signals are formed that return them to the required state. The universality of such a method is shown in the management of unstable objects. The central problem in the theory of automatic control, in particular, in the theory of closed systems, is the stability of the system. The 50s-60s of the 20th century was a period of rapid development of the methods of synthesis of such systems. In solving the problem of synthesis, the choice of quality criterion has a key place. Among the methods of synthesis of ABT, the methods of invariant and autonomous synthesis of such systems occupy a special place. In this theory, the ABT synthesis method based on the use of the integral criterion of quality assessment is prioritized. As expressed in the theory of automatic control, the synthesis problem of the optimal control of nonlinear objects with a limit in the form of control inequality, Pontryagin's maximum law, and Bellman's dynamic programs are partially used in solving new problems of calculus of variations. encouraged the emergence of changed methods. The methods of synthesis of acceptable systems are summarized and the theory of automatic control n. Relatively few studies have been carried out in the class of distributed parameter control systems. In some control objects, the a priori (initial) of the fixed mathematical model is not similar (inadequate) to the actual state of the object during the operation of ABT or its design. Often, due to the extreme complexity of the occurring process, it is practically impossible to create a mathematical model of the control object based on certain physical or chemical laws. This is certainly the result of external and internal feeding parameters, which cannot be measured when using ABT, change their readings. For this reason, a scientific direction called methods of identification of management objects appeared. The emergence of adaptive control systems made it possible to fill in the lack of a priori information and led to an increase in system efficiency. A simple closed extreme adjustment system belonging to the class of adaptive control systems can be divided into a separate class, and such control is considered a probabilistic problem. To solve it, methods of statistical solution and controlled random process theory are used. Continuous (analog) and continuous (digital) modeling methods are of great importance at the stage of scientific and practical research on the creation of ABT.

Automatic control in biotechnical systems involves the use of feedback and feedforward mechanisms, as well as various control algorithms and sensor technologies, to regulate biological

processes. Discover the importance of automatic control in enhancing efficiency and productivity in diverse industries.

Principles of Automatic Control

Feedback and Feedforward Control - Understand the key concepts of feedback and feedforward control and their application in biotechnical systems to ensure accurate and precise regulation.

Control Algorithms and Techniques - Learn about the various control algorithms and techniques utilized in automatic control, such as proportional-integral-derivative (PID) control, model predictive control, and adaptive control.

Sensor and Actuator Technologies - Explore the advancements in sensor and actuator technologies that enable real-time monitoring and control of biotechnical systems, ensuring optimal performance and safety.

Applications of Automatic Control

Bioprocess Control in the Pharmaceutical Industry - Discover how automatic control is vital in optimizing bioprocesses for pharmaceutical production, ensuring consistent product quality and yield.

Environmental Control in Agriculture - Learn how automatic control systems contribute to efficient environmental control in agriculture, enabling precision irrigation, nutrient management, and climate regulation.

Patient Monitoring and Control in Healthcare - Explore how automatic control plays a crucial role in patient monitoring systems, ensuring accurate and timely delivery of healthcare interventions.

Challenges and Limitations

Complexity of Biological Processes - Examine the complexities inherent in biotechnical systems and how they pose challenges for designing effective automatic control strategies.

Uncertainty and Variability - Learn about the uncertainties and variabilities in biotechnical systems and the strategies employed to address these challenges within automatic control frameworks.

Ethical Considerations - Explore the ethical considerations in the design and implementation of automatic control systems in biotechnical applications, ensuring responsible and safe practices.

Advancements in Automatic Control Technologies

Machine Learning and Artificial Intelligence - Discover how machine learning and artificial intelligence are revolutionizing automatic control by enabling adaptive and self-learning control systems.

Model Predictive Control - Understand the benefits of model predictive control, which employs model-based predictions to optimize control decisions and improve system performance.

Integration with Data Analytics - Explore the integration of automatic control systems with data analytics, leveraging big data to enhance system understanding and optimize control strategies.

Future Prospects of Automatic Control

Potential for Personalized Medicine - Uncover the potential of automatic control in personalized medicine, where individualized treatment plans and therapies can be dynamically adjusted for optimal patient outcomes.

Enhancing Sustainability in Biotechnology - Learn how automatic control systems contribute to sustainability in biotechnology by optimizing resource utilization, reducing waste, and promoting eco-friendly practices.

Integration with Internet of Things (IoT) and Cloud Computing - Explore the synergistic integration of automatic control systems with IoT and cloud computing, enabling remote monitoring, data storage, and real-time decision-making.

Conclusion. Automatic control is a critical component of biotechnical systems, enabling precise regulation, improved efficiency, and enhanced product quality. As technology advances, the integration of AI, machine learning, and IoT will unlock new possibilities and revolutionize the field of automatic control in biotechnical systems.

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